

**The Helium Magnetometer: An Instrument Providing  
Exceptional Sensitivity, Accuracy and Versatility**

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The helium magnetometer is a flight-proven instrument that has provided high quality performance on a variety of space missions. The most recent application has been on Ulysses where it is operated in the vector mode in which the magnetometer output consists of three voltages or digitized words corresponding to the three components of the heliospheric magnetic field. Some examples of the performance achieved on Ulysses will be presented, specifically, the low field-equivalent noise of  $5 \text{ pT}/\sqrt{\text{Hz}}$  and annual changes of magnetometer zero levels (offsets), which determine the accuracy, at a level  $\leq 3 \text{ pT}$ . The versatility of the helium magnetometer is exemplified by the capability to operate also in a scalar mode in which the output is a tone at the Larmor frequency and, hence, is a very accurate measure of the field magnitude. An instrument now being built for the Cassini Saturn orbiter, which will switch from vector to scalar mode on command to provide measurements of the planetary field that have an absolute accuracy of better than 1 nT, will be described. An advanced version of the sensor is now under development that includes replacement of the helium lamp by a diode laser tuned to the wavelength of the radiation used to optically pump metastable helium in the absorption cell. The use of the laser promises greatly improved sensitivity ( $\sim 1 \text{ pT}/\sqrt{\text{Hz}}$ )<sup>1/2</sup> and absolute accuracy ( $< 0.1 \text{ nT}$ ) and/or a significant reduction in the sensor size and mass. Recent developments in these areas will also be presented.

1. Measurement Techniques for  
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2. oral

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